[19] CHAPTER 3

PHYSICAL ENVIRONMENT

I. Natural Regions

131 The Bambara live in a region stretching between the 11th and 14th degrees of latitude north and between the 7th and 11th degrees of longitude west. They are grouped around the upper Senegal and upper Niger in the zone of basins bordered on the south by the Fouta-Djallon and the Guinea Ridge. The land is divided into several natural regions.

A. The Upper Niger

133 135 Framed by the outer ranges of the Fouta-Djallon and the cliffs of the Manding plateau, witness of the Pre-Cambrian shelf, the region is essentially schistose, with small veins of quartz and chimneys of dolerite; there are large intrusions of granite to the north 50 kilometers from Bamako, to the northwest and north of Siguiri, and to the south at the approach to the massif of the Fouta-Djallon. All the region is rich in gold. Several centers have long been exploited [316] by the natives by means of a network of narrow shafts which reach down to the auriferous seam. The whole region is encrusted with a shell of iron.

133 The region of the upper Niger is an immense plain covered with mammilliform hills. The plain rises gradually from the pass of Bamako to the mountains of the south, broken only by occasional dikes, such as that of Kouroussa-Kankan. The overall relief is very simple and monotonous; the local relief is very animated and varied because of the network of valleys hemmed in by steep cliffs 10 to 12 meters high.

The Niger, fed by the Tinkisso, the Milo, the Fié and, the Sankarani, reaches Bamako with a width of about 900 meters. It flows through a plain three to four kilometers wide in a southwest-northeast direction up to Timbuktu. It undergoes an annual rise which depends solely on the amount of rainfall. From Kouroussa to 132 Bamako the first rains at the end of April, and then of May and June, begin to feed the river; the flood period begins in June. At the time

132 of high water, part of the narrow plains bordering the river are inundated.

133 At the pass of Bamako the cliffs on the left bank are close to the river and hem in the city. The pass is marked by the appearance of rapids (Sotuba, Kénié), for the river meets for the first time the [20] sandstone it cuts through. The water is highest at Bamako around September 22 and begins to subside towards October 15. It is lowest around April and May.

137 The vegetation is quite unvaried. Species of great forest trees are found in the ravines of the mountains to the south; the small Sudanese forest covers the whole Niger region up to Bamako where the layer of laterite is thin. It is a forest of deciduous trees; the trees shed their leaves and flower in the middle of the dry season while they are still bare; then the leaves appear before the return of rainy season which marks the awakening of the herbaceous plants. Let us note particularly the karite [shea] tree (Butyrospermum Parkii) which is the most widespread and characteristic of the Sudan; the néré (Parkia biglobosa); the téli (Erythrophloeum guineense); the lingué (Afzelia africana); the caïlcedrat (Khaya senegalensis), as well as enormous gramineous plants of the Andropogon family which are more abundant in the humid depressions than on the plateaus.

[134] However, large areas covered with a layer of laterite are bare except for some scanty gramineous plants: this is the "bowal." These immense iron flats, barren of humanity, make excellent hunting

136 grounds. Buffaloes, panthers, Derby's elans, various kinds of monkeys, elephants, antelopes, lions, wart hogs, hippopotamuses, and crocodiles live there. The glossine (tsetse fly) abounds in the same region.

241 Between these immense, desolate bowals grow rice, millet, and fonio (Digitaria exilis), the most wretched of the world's cereals and the most important for ritual purposes.

133 In the valleys, outside of the beds of laterite gravel, one finds the small forest or cultivation in newly cleared places and prairies are found in the sections that are annually inundated.

B. The Ségou Basin

This is a plain framed by the sandstone of the Manding and Dogon plateaus, by the Goundam range and the range south of the Dehar near Bassi Kounou.

133 or sandstone. Some of these bars result in handsome waterfalls. Between Bafoulabé and Kayes, the Senegal has two important waterfalls: those of Gouina and Félou. The Senegal flows between banks 300 to 800 meters apart, forming a channel from 10 to 12 meters deep; it is subject to periodic floods depending on the rainfall.

Two kilometers downstream from Kayes the river is joined at the right by the Kolombiné, which, north of Nioro, forms the Korkodio marsh, a veritable lake in the rainy season.

Near Nioro, the Sarakollé Massif joins the valley of the southern Hodh in hilly outcroppings; to the east of Nioro, one again finds fragments of sandstone and of white marble.

This region is characteristic of the Sahel savanna. The
137 karite tree disappears in favor of shrubs: doum palms (Hyphaene thebaica), and cram-cram (Cenchrus catharticus). The climate being [23] [chart appears here in the original text] drier, the brush becomes thorny, but one still finds the baobab, numerous Combretaceae, and the precious Palmyra palm.

II. Climate and Meteorology

132 This region belongs to the zones of Sudanese and Sahelian climate. Its climate may be characterized thus:

A single rainy season, in summer;

Annual precipitation from 2,000 to 250 millimeters, decreasing from south to north;

Maximum precipitation in August.

A. Temperatures

The temperatures offer:

- a maximum corresponding to the passage of the sun to its zenith (March to May) with an absolute maximum of $>40^{\circ}$;
- a secondary maximum corresponding to the end of the rainy season;
- a minimum corresponding to the maximum remoteness of the sun (December-January) with an absolute minimum of $<15^{\circ}$;
- a secondary minimum corresponding to the maximum precipitations.

132 The vapor pressure follows fairly closely the rainfall curve and has a maximum of > 25 millibars in August (1).

1. This information was furnished to us by M. de Lorme of the Meteorological Service of Bamako.

The year is divided into two seasons, the dry season and the rainy season or "winter."

[24] B. Winds

The different types of weather are determined by the succession of different and quite distinctive air currents. Practically speaking, only two air currents are of interest in the region: the harmattan and the monsoon.

The harmattan -- This is a wind which circulates on the southern face of the continental African anticyclone. It blows generally from the east, and its rate is slow. It is a dry wind (vapor pressure about 10 millibars, which may drop below 5 millibars).

The southwest monsoon -- The air which circulated around the Saint Helena anticyclone is deflected as it crosses the equator and circulates around its Saharan thermic depression.

This wind blows from a general southwesterly direction, is very slow and very humid (vapor pressure about 25 millibars). The depth of the monsoon varies between 1,000 and 2,500 meters in general. It is surmounted by the harmattan, under which it thrusts itself like a wedge.

The zone where these two currents meet forms the intertropical front (F.I.T.), axis of the Saharan depression. This F.I.T. is clearly oriented east-west and follows slightly behind the movements of the sun. It oscillates between 6° north (January) and 21° north (July), climbing from January to July and dropping back afterwards. The progress of the F.I.T. takes place by jumps because the monsoon establishes itself in successive waves.

The regions to the north of the F.I.T., where the harmattan prevails, are in the dry season.

The regions to the south of the F.I.T., where the monsoon prevails, are in the rainy season.

132 This explains why the rainy season is progressively shorter as one goes north.

C. Rainy Season

At ground level the southwest monsoon prevails.

This is a wind from a general southwesterly direction, of very little speed, which drops more and more as one goes north. It is very humid and its vapor pressure is about 25 millibars.

Upon contact with the ground it is heated and rises, giving birth to vertical clouds from which may fall rather heavy showers, stormy or not, but localized, with calm or with moderate winds at ground level. The clouds undergo a great variation during the day and are developed to their maximum at the end of the day. The showers are generally confined to the end of the afternoon and the beginning of the night.

The normal height of the monsoon varies between 1,000 and 2,500 meters. It is surmounted by the harmattan.

The harmattan does not reach the ground except after "squalls." Its direction [25] is from the east, and its speed is then very great; its temperature and vapor pressure are lower than those of the monsoon, although it is generally at the saturation point.

Monsoon rains -- When currents meet within the monsoon, compact cloud masses several kilometers high may form, from which fall abundant and generalized precipitations called "monsoon rains." These cloud masses are virtually stationary; a fine, continuous rain falls from them, and the rare rifts in the clouds generally occur at sunset. These rains may be accompanied by sporadic storm phenomena. This type of weather lasts on the average from several days to about ten days, and the cloud system is reabsorbed in place when it is no longer sufficiently fed.

In the south these rains occur several times during the season, while in the north they are practically unknown.

Squalls -- They are commonly called "tornadoes." They occur when the monsoon at ground level becomes lighter than the east wind which is normally found above it.

132 Process of formation -- The surface of separation between monsoon and harmattan being practically horizontal, there forms there for some reason (generally, the thermic rise of the monsoon in contact with the overheated ground) a wave which is amplified more and more. The monsoon in rising cools and produces a vertical cloud formation. At the same time, the horizontal speed of the monsoon being slow and the harmattan rapid, the wave and the cloud have a tendency to move westwards. A hollow then forms in front of the wave of the monsoon, and the base of the harmattan drops towards the ground.

In the mature stage, in front of the rising column, a whirlwind is formed with a horizontal axis which rotates without touching the ground; thus, the impression of calm one has before the arrival of a squall. This whirlwind carries low, black clouds which yield no precipitation, but which move very rapidly in the form of a roll or cylinder.

Then comes a whirlwind of the opposite rotation, to which the spread and the speed of the whirlwind are added, hence, a violent gust of wind (the speed may attain 100 kilometers per hour) from a general easterly direction. The rain follows almost immediately. It falls in the form of a very violent downpour (the instantaneous intensity of the precipitation may exceed a millimeter per minute) and may last as long as an hour. It is accompanied by considerable storm phenomena and sometimes by hail.

Then, during two to three hours, generally, a fine, continuous rain falls, coming from rather high stratiform clouds.

The mass moves westwards with the average speed of the upper east wind (50 kilometers per hour generally).

Finally, when the stratum of the anterior monsoon offers an obstacle of sufficient resistance, the squall must rise above it; it rapidly loses its intensity and dies out if it is not regenerated by favorable conditions (thermic rise).

[26] The squalls range themselves generally in a north-south direction, forming a "squall line," a veritable cloud barrier which may mount up to 15 kilometers altitude. Some of these squall lines may be 1,000 kilometers long and extend from Timbuktu to Abidjan; they may cover 3,000 kilometers and cross all of French West Africa, but most have a far more modest extent and range.

132 After the passage of a strong "squall line," there is generally a break in the weather for two or three days without rain or storms, but several small squall lines may succeed each other during a day. At the height of the season there is an average of about ten squalls a month. They are responsible for the most violent storms, rains, and winds.

The squalls undergo a rather pronounced diurnal variation, and their intensity is at its maximum at the end of the afternoon and at the beginning of the night.

D. Dry Season

At ground level the harmattan prevails. This is a wind of a general east to northeast direction; its speed is feeble but undergoes a marked diurnal variation, for it is subject to considerable thermic differences. At night there is almost absolute calm, then the east wind sets in. At first it blows regularly, then, during the hot hours, in widely scattered "gusts" following the thermic rises that are produced from contact with the overheated ground, then it dies little by little at night. The vapor pressure is about 10 millibars and may drop to less than 5 millibars.

There is a great diurnal increase in temperature, with the maxima capable of passing 45°.

The low humidity does not permit condensation of large clouds, and the only clouds to be found are high ones.

The high temperatures cause a very considerable thermic instability over the sand and produce effects of "hot air wavering" and of "mirage." Visibility is sometimes substantially reduced by particles of sand suspended in the air, forming what is called the "dry fog." The fogs are generally born in the north and are carried afar by the wind.

Winter rains -- Air coming from high latitudes sometimes descends as far as French West Africa, notably in January and February. Rather elevated clouds are then formed, and the sky remains overcast for two or three days. Light rains may fall, which generally do not reach the ground, notably in the northern regions. The clouds also may lead to feeble high-altitude storms.

This phenomenon generally occurs two or three times a season.